Space Weather Technical Forecast

Issued on Friday, 25 November 2022 at 01:16 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Slight chance of Minor Geomagnetic Storm (G1) intervals.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Very Low at background levels. There are 4 sunspot regions on the visible disk, all of which are relatively small in area and magnetically simple, with most showing signs of decay. No new Earth-directed CMEs were observed in available imagery.

Solar Wind / Geomagnetic Activity: The solar wind at L1 persisted at background levels, starting at 290 km/s and then gradually increased to reach slightly elevated levels by the end of the day. The density has been mostly above average, increasing to peak at 43 ppcc at 24/1930 UTC, but then declined at the very end of the day back to average levels. The total IMF, Bt, was at weak levels until the evening, then strengthen to reach Strong levels, peaking at 16 nT at 24/2340 UTC. The north-south component Bz, varying weakly until the evening, then fluctuated between -9nT and 11nT. Phi angle frequently fluctuated between positive and negative throughout the day. The solar wind parameters indicated that a co-rotating interaction region (CIR) had arrived. Geomagnetic activity remained Quiet (Kp 0-2).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10MeV) as measured at GOES16 has remained at Background levels. High energy electron flux (greater than 2MeV) at GOES16 was at predominantly background levels. Electron fluence levels remained well below Active (1e8 integrated pfu) levels. Observed fluence at 25/0001 UTC was 1.33e6 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to remain Very Low, with a chance of C-class flares and a slight chance of isolated M-class X-ray flares. Later in the forecast period new regions may rotate onto the visible disc, although any potential regions are not expected to be significant.

Solar Wind / Geomagnetic Activity: Several recent CMEs occurred on or close to the Earth-Sun line which could give glancing blows on passage. The CME from the C7 flare at 22/0727 UTC and a CME from the C4 flare of AR3151 at 22/1900 UTC are both likely to pass beneath Earth's orbit but may produce minor peripheral impacts tomorrow (26th).
Slightly elevated solar winds are expected today today (25th) due to the arrival of a HSS from CH47/+, with a chance of temporary elevated solar wind speeds developing. Further enhancements in the solar wind are possible through the rest of the forecast period, from either the weak passing CMEs or from a connection to a HSS from CH48/+ later tomorrow (26th).
Quiet to Unsettled (Kp 1-3) geomagnetic activity at first is expected to increase to mostly Unsettled to Active (Kp 3-4) from late today and then persist until late day 3 (27th), with a chance of G1/Minor geomagnetic storm (Kp 5) intervals. Geomagnetic activity is expected to

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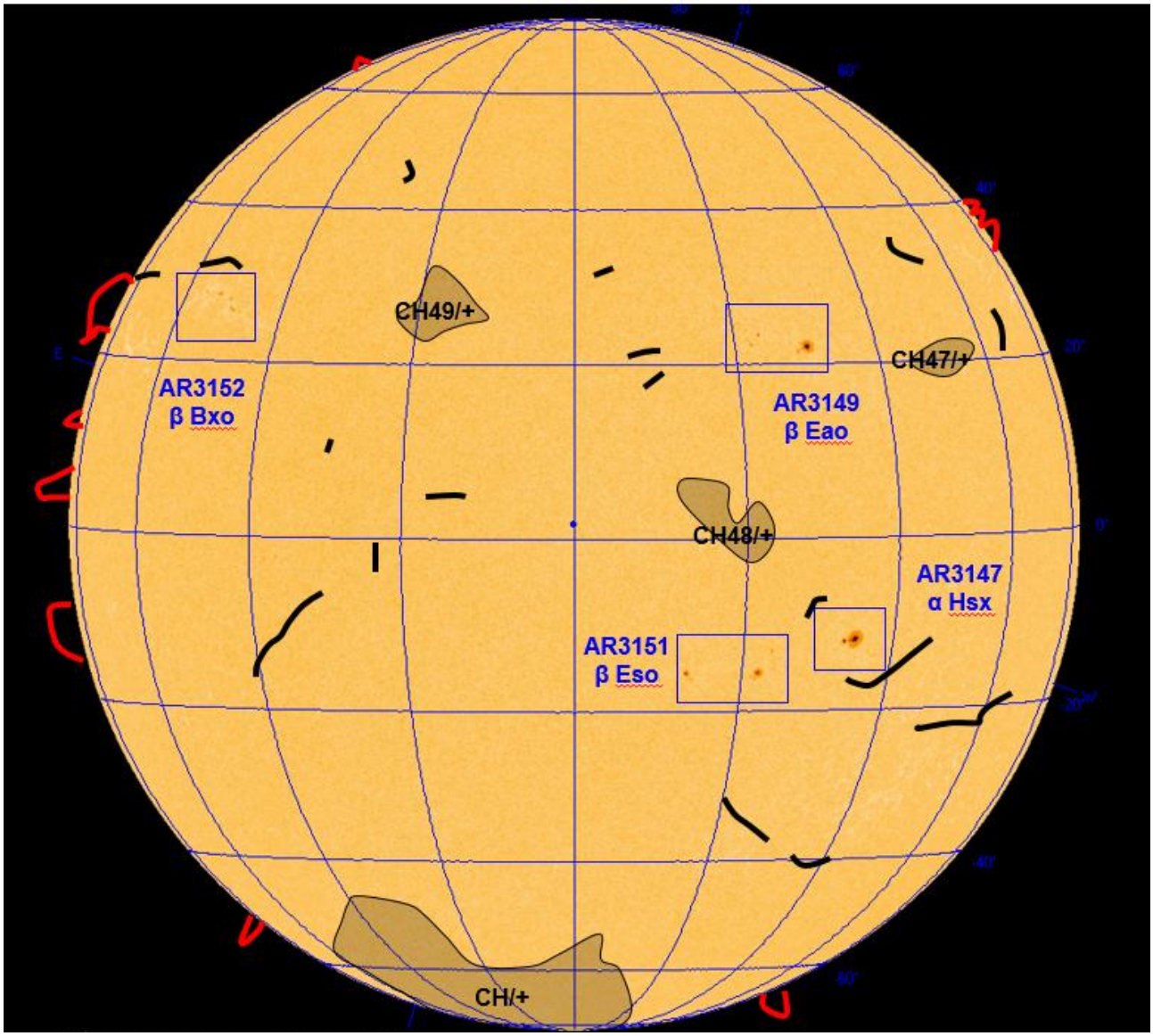
gradually decline from late day 3 (27th) and especially through day 4 (28th) to become Quiet to Unsettled again.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) observed by GOES16 is expected to remain at Background levels throughout. The high energy Electron flux (greater than 2 MeV) at GEO is forecast to be close to background at first, before rising to Moderate to High levels later in the period in response to HSS from coronal hole. The persistence of any enhancement is low confidence. The associated 24-hour integrated fluence is expected to remain below Active (1e8 integrated pfu) throughout, albeit with a rising trend.

Figure 1. Solar Analysis Valid 24/1945 UTC (note that the SDO magnetogram was not available).



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

Several recent CMEs occurred on or close to the Earth-Sun line, which although may have some partially Earth-directed components, are likely to only give some minor effects if any arrival occurs. The CME from the C7 flare at 22/0727 UTC and a CME from the C4 flare of AR3151 at 22/1900 UTC are both likely to pass beneath Earth's orbit but may give a glancing blow with minor peripheral impacts tomorrow (26th).

Slightly elevated solar winds are expected today today (25th) due to the arrival of a HSS from CH47/+, with a chance of temporary elevated solar wind speeds developing. Further enhancements in the solar wind are expected from a connection to a HSS from CH48/+ later tomorrow (26th).

Quiet to Unsettled (Kp 1-3) geomagnetic activity at first is expected to increase to mostly Unsettled to Active (Kp 3-4) from late today and then persist until late day 3 (27th), with a chance of a G1/Minor geomagnetic storm (Kp 5) intervals. Geomagnetic activity is expected to gradually decline from late day 3 (27th) and especially through day 4 (28th) to become Quiet to Unsettled again.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	20	30	20	10
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: SDO/AIA 211 images from previous rotation (left) and currently (right), showing similar coronal hole features.

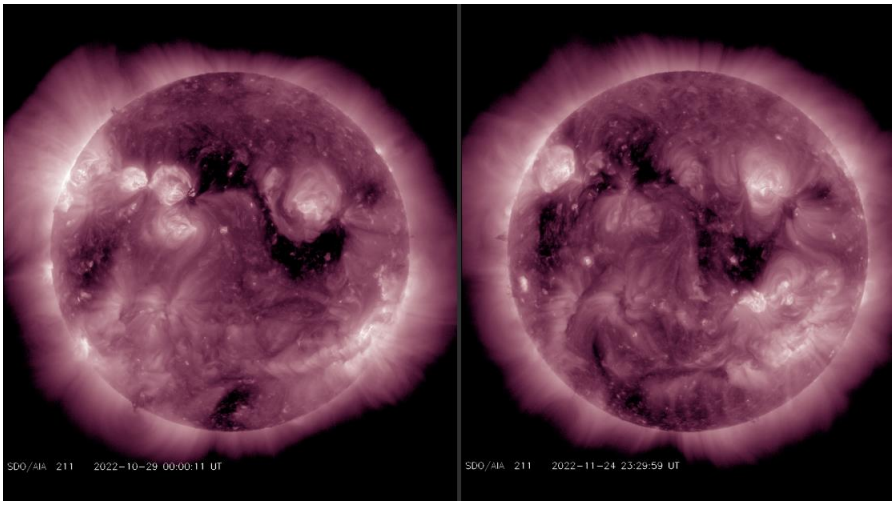

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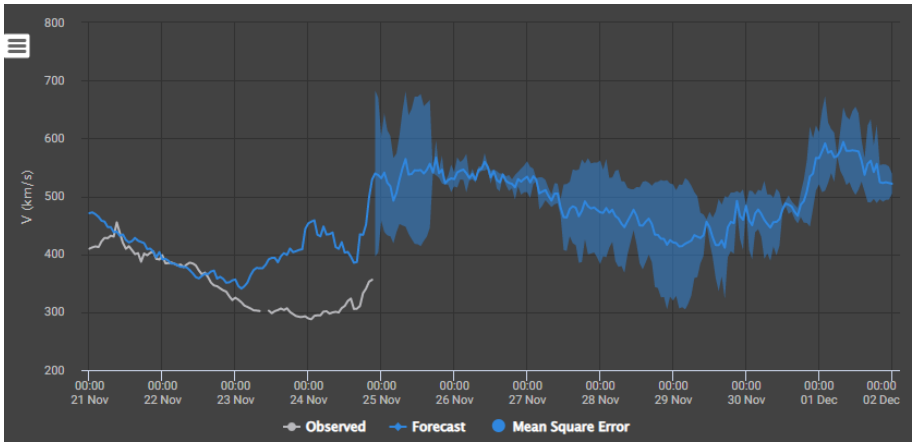
Figure 3: Solar wind persistence model.



Radio Blackouts - X-Ray Flares:

Solar activity is forecast to remain generally Very Low throughout the period, with a chance of C-class flares and a slight chance of M-class flares.
There are currently four numbered sunspot regions on the visible disc. AR3147, in the southern hemisphere, has reduced slightly in size while remaining a Hsx/Alpha. AR3149 in the northern hemisphere, continues to decrease in size and spot number, and is now classified as an Eao/Beta. AR3151 in the southern hemisphere, historically the most active region, has shown further elongation and so is now Eso/beta, with rudimentary penumbra on the trailing spot. AR3152 continues to emerge from the eastern limb, and is currently classified as Bxo/Beta.
Later in the forecast period new regions may rotate onto the visible disc, although any potential regions are not expected to be significant.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	10	10	10	10
Very Active	R3 to R5 X Class	No	1	1	1	1

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Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10MeV) at GEO, as observed by GOES16 is currently at background levels and is expected to remain at this level throughout.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	No	1	1	1	1
Very Active	≥ S3 *	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2 MeV) observed by GOES16 is forecast to be predominantly Moderate in response to the arrival of a coronal hole HSS today from CH47 and then another HSS from CH48 late tomorrow. Flux levels are likely to reach High later in the period, especially during the peak of the diurnal cycles. However, any glancing blows from the potential CME arrivals could act to suppress observed flux. Therefore confidence is low.
The associated 24-hour fluence is forecast to remain below the Active threshold, but with a rising trend. Therefore the REFM is currently offering good guidance showing the rising trend, but the increase to Active levels is considered unlikely.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ 2 MeV ≥ $1x10^8$	No	5	10	20	30
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 4: Met Office REFM model.

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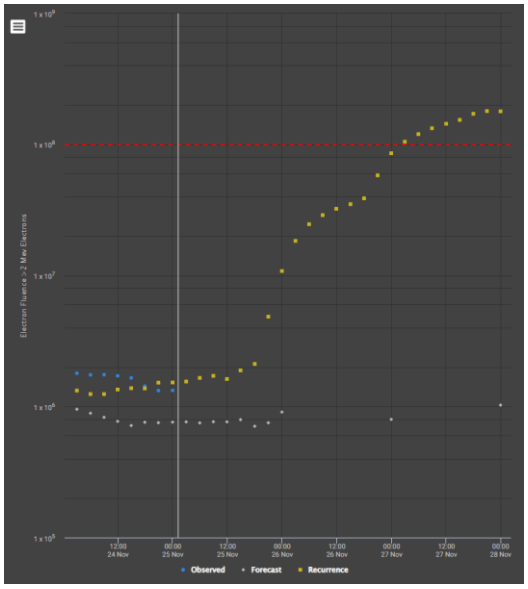

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